

# The Future of Manufacturing: Industry 4.0 for the Intelligent, Sustainable Enterprise



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## Executive Summary

The manufacturing environment is changing. Manufacturing's focus is no longer on capacity, cost, and productivity alone; it is now also on the ability to respond quickly to customer and market changes while still controlling costs and quality.

Today, new trends are emerging that present complex challenges, not only placing supply chains and manufacturing at the center of business success but also making them differentiators in a company's strategy. Customers demand individualized, sustainable products, and manufacturers need to produce smarter products in smaller batch sizes while maintaining high quality in volatile, competitive markets. Lifecycles of products are getting shorter and shorter, which demands faster time to market to stay competitive. Business models are also shifting from selling products to delivering complete solutions and products as a service.

At the same time, there is intense price and margin pressure that requires manufacturers

to become more efficient and drive productivity gains while optimizing resource utilization. Production processes must evolve to support highly variable demand in a demanding market. Beyond labor, productivity, and asset efficiency, the next performance leap in factories will be through end-to-end effectiveness and connectivity of production and business systems.

Multimodal manufacturing is becoming the new normal, where you must support both mass and individualized production with increasing levels of variable configurations and shorter lead times. Sustainability mandates require optimized manufacturing processes that minimize negative environmental impacts while conserving energy and natural resources and establishing safe working conditions.

In response to these shifts in market expectations, manufacturers look to develop intelligent factories and leverage digital technologies to gain significant improvements in productivity, quality, flexibility, sustainability, and service.



## Challenges in Manufacturing

Today, many companies still work in silos, which can result in a lack of data transparency for consistent performance measurement across plants and processes. And manually intensive production lines and machine operations can make it a challenge to adopt the modular and hybrid manufacturing processes that are required in this dynamic environment. All of this can make it difficult to optimize existing labor and equipment capacity to deliver on customer expectations.

Operational excellence in manufacturing and across the supply chain is now seen as a key differentiator for companies, allowing them to address complexity, minimize risk, and meet cost objectives.

This often starts by leveraging Industry 4.0 for best practices, methodologies, and principles to digitally transform manufacturing processes into smart, connected, and intelligent factories. By leveraging advanced automation and integrating shop-floor processes, companies are optimizing performance while ensuring compliance and meeting sustainably goals and mandates.

### **SOLUTION**

A focus on digitalized, end-to-end processes is required to realize the full potential of intelligent factories, bringing automation and business context to the entire manufacturing process and integrating it with sales, finance, R&D, logistics,

and service. Additionally, companies must directly connect to their network of suppliers, contract manufacturers, and innovation partners to enable the entire ecosystem to operate as one unified network.

Technologies such as AI, machine learning, and analytics need to be embedded into products, processes, and applications. Similarly, ensuring connectivity to “things” – such as IT and operational technology (IT-OT) integration and seamless connectivity to business systems – means companies can truly experience a data-driven enterprise to redefine business processes, enable new business models, and reduce waste.

With the move to the cloud, technology enablers also play a key role in supporting IT-OT integration with data ingestion and management through superior edge solutions. This data, along with other unstructured data, provides the foundation for analytics to support simulation and predictive processes.

Industry 4.0 practices help establish intelligent factories that are using data, intelligence, and analysis to run as autonomously as possible while delivering both mass-produced and individualized products at scale. In addition, companies are leveraging intelligent assets to drive predictive maintenance scenarios and empowering people to work more efficiently and make better decisions by equipping them with the tools and information at their point of work.

# Digitalizing Manufacturing to Address Challenges

## RESILIENT SUPPLY CHAINS SERVE LOCAL DEMAND

For global manufacturers to reduce risk and better serve a global customer base, many companies are rethinking strategies and bringing supply closer to the customer. Having factory capacity distributed across the globe also helps ensure manufacturers have protection in case of a global shock to the system.

## AUTOMATION HELPS DIGITALLY TRANSFORM MANUFACTURING

As the price point of Industry 4.0-enabling technologies decreases and the capabilities increase, so does the adoption of automation in manufacturing sites worldwide. Automation can help reduce the cost of building smaller factories closer to the end customer and make it possible to respond to local market demands with the agility to pivot to new products more quickly. But automation does not remove the need for human intervention and decision-making. In this digitally transformed manufacturing operation, the role of individuals is still important to, for example, plan and replan production to meet demand changes, manage and maintain facility assets, or ensure that equipment is performing at optimal levels.

## LEVERAGING THE POWER OF INDUSTRY 4.0-ENABLING TECHNOLOGIES

The use of Industry 4.0-enabling technologies such as the Internet of Things (IoT), machine learning, AI, robotics, digital twins, 3D printing,

blockchain, and 5G is a key cornerstone for the digitalization of manufacturing operations. IoT-enabled equipment can generate unparalleled levels of information and insights. This data can then be leveraged by machine learning and predictive analytics to drive productivity, optimize operations, and instill predictive quality and maintenance processes into every relevant step of the manufacturing process.

### Connectivity Across Equipment Types

It is crucial for businesses to have connectivity across all equipment types to provide real-time visibility across multiple industrial operations systems.

Connecting the production processes of process-oriented manufacturing with an enterprise system requires a flexible IT platform to serve as a central information hub for the extraction and processing of data from different sources.

The availability of integrated data facilitates the assessment of operations that help view, measure, and compare the performance of plants and assets with different automation infrastructures. It allows the analysis of plant activity both in real time and historically to measure, analyze, and adjust manufacturing process performance. This interoperability between the shop-floor system and business systems enables the visualization of data from any of the integrated shop-floor sources to provide measurable KPIs.



## **VISIBILITY AND CONTROL ACROSS FACTORY OPERATIONS**

As repetitive manufacturing operations are automated, employees are freed to focus on more challenging and value-added activities. It is crucial to empower these employees with real-time, role-based information in an easily consumable and informative way to manage, control, and optimize manufacturing and shop-floor operations.

This visibility provides data from the “shop floor to the top floor” and enables insight into KPIs such as:

- Planned versus actual production
- Actual emissions and waste versus sustainability targets
- Enhanced overall equipment effectiveness
- Actionable manufacturing analytics
- Traceability of what was produced and which materials went into those products
- And more

## **COMPLETE TRACEABILITY AND GENEALOGY**

The pace of today’s digital economy also increases the expectations for speed of innovation, responsiveness, and traceability across the supply chain. This can be solved by having a complete view of all production steps, material movements, and operational decisions from product design to delivery. Products must be tracked from raw materials and intermediates to finished products at a customer’s location.

And with the help of genealogy, the assembly of a product can be traced through the manufacturing process. Companies can not only achieve regulatory compliance, but they can also create the opportunity to analyze and improve production processes and quality of any product produced at any plant at any time.



### REAL-TIME PERFORMANCE DASHBOARDS

The value of real-time data is only realized when it is turned into actionable insights and decision support tools. Providing role-based information at the fingertips of employees to help them make key decisions at the point of work in real time empowers them to be more productive while improving the productivity of processes. This, in turn, creates an environment of continuous improvement.

For example, a plant manager needs an integrated view of operational performance across all production lines at an individual plant, while a COO needs a view across all factories to analyze productivity, throughput, efficiency, and quality of all facilities in real time.

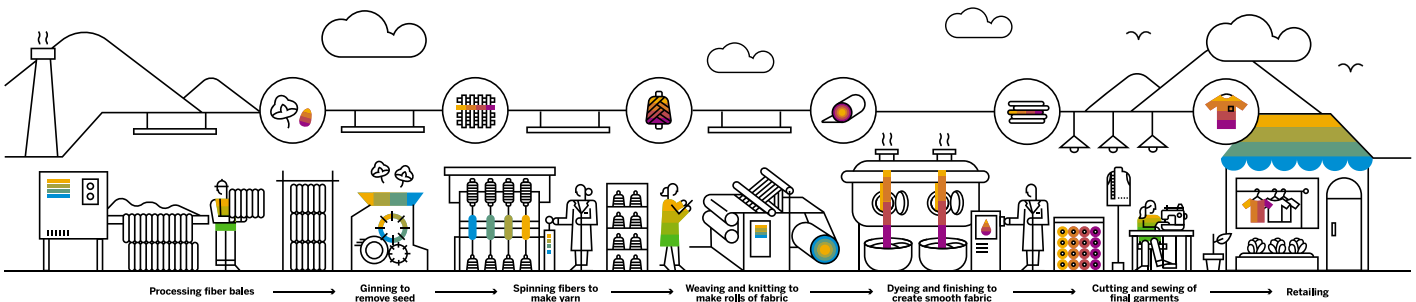
### SUSTAINABILITY ACROSS MANUFACTURING PROCESSES

Manufacturing operations can play a key role in building a sustainable environment, reducing carbon footprints, eliminating waste and operational by-products, and providing a safe workplace. Achieving these goals requires cross-functional practices that influence product and process design as well as operational principles.

The future of digital manufacturing is bright with numerous opportunities for a sustainable world. Through SAP's Climate 21 initiative, we strive to be part of this movement for a sustainable business and world. We encourage our customers to start their digital transformation journey with SAP® solutions for digital manufacturing to help the world run better and improve people's lives.

### RECRUITING AND RETAINING TALENT

In a business environment that is increasingly weighted toward the employee, recruiting and retaining your workforce is an ever-increasing challenge. And it is not only pay and benefits that attract the 21st-century worker. They want to work for an ethical company that manufactures sustainable products. And they want to work with state-of-the-art, innovative systems and tools that provide information at their fingertips – anywhere, anytime, and on any device. Cloud and mobile technologies now make this a reality in manufacturing and operations.



## Realize Business Value with SAP Digital Manufacturing Cloud

The digital revolution is no longer just a buzzword; it has already made its way into both discrete and process manufacturing companies across a multitude of industries. With the interaction of the IoT platform and enterprise systems, you can digitally map the entire product lifecycle from the first stage in the design phase to end-user delivery.

And with increasing demand for more agile, service-oriented, and individualized products that contribute to a sustainable circular economy, the stakes are high. This requires a digital manufacturing system that empowers key stakeholders to analyze global and plant-level manufacturing performance and enforce standardization and associated causes through intuitive, preconfigured process controls and decision support analytics.

Improving the visibility and reporting consistency of data from different manufacturing operations

and automation systems is required, and it is achieved by integrating multiple systems and standards-based interfaces. Cloud-based solution companies can gain faster and more consistent insights from root-cause analysis, advanced algorithms, and machine learning that facilitate continuous business improvement.

Visibility into manufacturing processes and plant cadence supports better, more transparent production management processes and related metrics to assess and resolve quality and productivity issues quickly while reducing warranty and liability risk.

The SAP Digital Manufacturing Cloud solution can help you meet market-of-one demand, handle extreme product variability, and maintain productivity, margin, and quality levels. It can also help improve customer satisfaction through optimized manufacturing resources while improving quality, efficiency, and equipment downtime.





## The **Future** of Manufacturing

Many manufacturing executives have the opportunity to enable their operations to become an area of opportunity and innovation. To address the challenges coming from demanding customers who are looking for innovative, individualized, and sustainable products, you must digitalize manufacturing processes and facilities. This enables the agility and productivity required to respond to and take advantage of opportunities. And you must do it in a sustainable and profitable way.

Knowing exactly how, where, and when products will be built is key for every company, especially in a fast-paced world with ongoing uncertainties

and disruptions in the supply chain. Thus, it is essential for your business to horizontally and vertically integrate production, operate in the cloud, and automate processes with an integrated, AI-supported corporate management system. With the digital transformation of manufacturing, your business can improve its operational efficiency and reduce costs while ensuring the highest-quality manufactured products.

Manufacturing digitalization and connectivity across processes and infused business data is the path to accelerated innovation, agile manufacturing processes, and environmentally sustainable operations.



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